



Installation and Operation Instructions

Part No. CGCDXGAS001A00 (Calibration Service Kit)
CGCDXPRM001A00 (User Interface Program)

SAFETY CONSIDERATIONS

Installation of this accessory can be hazardous due to electrical components and equipment location (such as a ceiling or elevated structure). Only trained, qualified installers and service mechanics should install and service this equipment.

When installing this accessory, observe precautions in the literature, labels attached to the equipment, and any other safety precautions that apply.

- Follow all safety codes.
- Wear safety glasses and work gloves
- Use care in handling and installing this accessory.



ELECTRIC SHOCK HAZARD

To avoid the possibility of electrical shock, open and tag all disconnects before installing this equipment.

INTRODUCTION

Carrier's CO₂ sensors monitor carbon dioxide levels in a building's air and regulate the ventilation system. The control is designed to regulate ventilation in compliance with ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers) Standard 62. The sensors have a membrane-covered waveguide and sample chamber that produce stable, reliable, and accurate readings. To maintain accuracy over time, the sensor must be calibrated annually.

Calibration Service Kit — The accessory calibration service kit (Fig. 1) provides the tools necessary to perform calibration maintenance and customize operating parameters on Carrier CO₂ sensors.

The calibration service kit (part no. CGCDXGAS001A00) includes:

- Calibration Adapter Blanket (CAB)
- Tygon® Tubing
- Formed Tube
- Clip Retainers
- Bottle of N₂ gas (0 ppm CO₂)
- Bottle of CO₂ Gas (~2,000 ppm) in Nitrogen
- Pressure-Regulator Valve
- User Interface Program (UIP) Disk (3.5 in.)
- RS-232 Serial Cable

NOTE: The UIP is used for setting the control parameters with an IBM-compatible personal computer. The UIP runs on the DOS operating system and is menu driven.

User Interface Program (UIP) — An IBM-compatible personal computer and the accessory user interface program (UIP) are required to adjust or customize the sensor's output parameters. The UIP kit is included as part of the accessory service kit, but can also be purchased separately. The UIP kit does not include the calibration components.

The UIP has several features to make calibration and setting changes easier:

- Single-screen format allows easy access to sensor information
- Fast and simple calibration procedure using Quick field calibration option
- Convenient On/Off self-calibration feature
- Custom screens
- Maintains software record of sensor settings for backup

The UIP kit (part no. CGCDXPRM001A00) includes:

- User Interface Program Disk (3.5 in.)
- RS-232 Serial Cable



Fig. 1 — Calibration Service Kit
(Includes User Interface Program)

PRE-INSTALLATION

Hardware and Software Requirements — The following computer hardware and software is required to run the user interface program:

- IBM-compatible personal computer (8086-based)
- 640K RAM
- 1 megabyte hard-disk storage
- 80 column monitor (color, monochrome, or black and white)
- MS-DOS (version 3.3 or later)

NOTE: The UIP is for IBM-compatible personal computers using DOS 3.3 or higher. A Macintosh computer with a DOS simulator package *cannot* be used to run the UIP software.

Complete Pre-Installation Checks — Remove accessory packaging and inspect shipment for damage. File claim with shipping company if accessory is damaged or incomplete.

INSTALLATION

Load User Interface Program (UIP) — The UIP is a DOS software program developed to communicate with the CO₂ sensor. The UIP allows the user to read CO₂ levels on units with no display, verify active sensor settings, customize output parameters, and perform calibration adjustments. The program allows a computer file to be created after every setting or calibration change to document any changes to the sensor.

NOTE: Throughout this instruction, UIP commands and command keys are designated with **bold** text.

Load the program disk into the floppy drive. Create an application directory named "UIP" on the hard drive and copy the program files into this directory. To create the directory and copy files onto the hard drive, enter the following at the C: prompt (make appropriate substitutions for drive holding disk).

```
C:\> MD\UIP
C:\> CD UIP
C:\UIP> COPY A:\*.*
```

As an alternative, the UIP can be run directly from the floppy (A:) drive.

To run the UIP, enter **2001UIP** from either the C:\UIP> or A:> prompt, as follows:

```
C:\UIP> 2001UIP
```

Before the program begins, a pop-up window appears, allowing selection of the computer serial port that will be used to connect the communications cable to the CO₂ sensor. Use the up/down arrow keys to position the cursor on the desired port and press **Enter**.

Connect Computer to CO₂ Sensor — After the UIP is successfully installed, the sensor's cover may need to be removed to connect the RS-232 cable to the sensor terminal block and/or gain access to the sample chamber for calibration. Remove the cover and connect the cable as follows:

1. As shown in Fig. 2, press the spring tab at the top end of the case (Fig. 2, Item 1) and lift the cover away from the base.
2. Release the two spring clips from the right-hand edge of the circuit board (Fig. 2, Item 2) and lift away from its engaged position. See Fig. 2.
3. Connect the RS-232 cable to the terminal block. The pin assignments of the terminal block are shown in Table 1. The table also lists the terminal block designations and maximum electrical ratings for the unit. See Fig. 3 for terminal locations on the circuit board.
4. Connect the DB-9 connector of the RS-232 cable to a serial COM port on the back of the computer. Use the port specified when the UIP was first started.

Table 1 — Terminal Designations

TERMINAL NO.	TERMINAL DESIGNATION	MAXIMUM ELECTRICAL RATINGS		
		Voltage	Sink Current	Source Current
TB-1	Power Supply	24 vac/30 vdc	500 mA	—
TB-2		Not Used		
TB-3	Relay Contact	24 v	1.5 A ac; 750 mA dc	
TB-4	Relay Contact	24 v	1.5 A ac; 750 mA dc	
TB-5	Power Ground	—	—	—
TB-6	RS-232 Red	EIA Standard	—	—
TB-7	RS-232 Wht	EIA Standard	—	—
TB-8	RS-232 Blk	EIA Standard	—	—
TB-9	+ V Out or current sink	10 vdc	10 mA	20 mA
TB-10	Signal Ground or Current Source	0 vdc	10 mA	20 mA

LEGEND

EIA — Electronic Industries Association

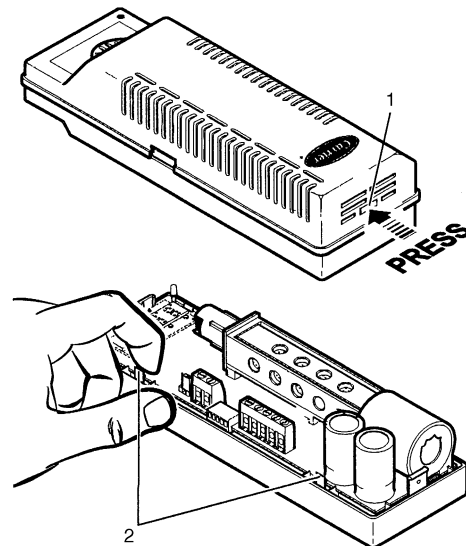


Fig. 2 — Removing Cover and Circuit Board

⚠ CAUTION

Static electricity can damage the circuit board. Be sure to use a properly grounded antistatic mat and/or grounded wristband while handling circuit board. See Handling the Circuit Board, page 6.

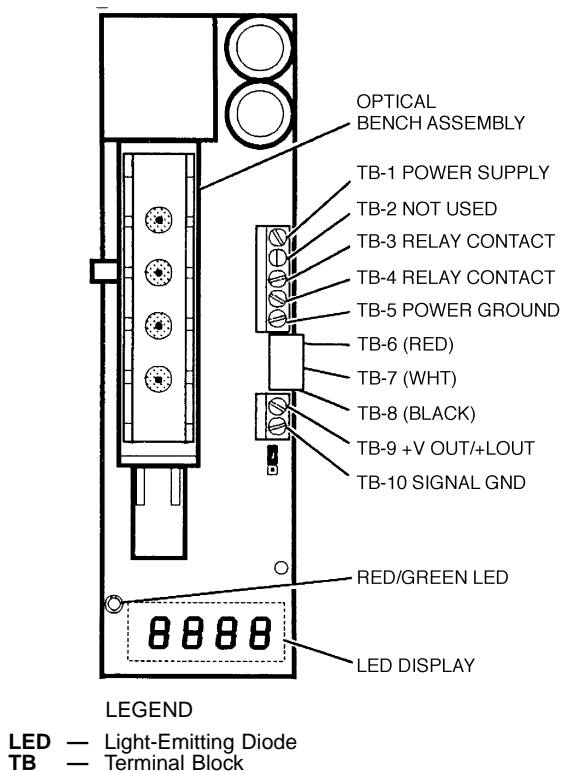


Fig. 3 — Sensor Terminals

OPERATION

Main Menu — The UIP main menu consists of a single screen divided into three different sections: General Information, Controller (Sensor) Settings, and Calibration.

A highlighted field indicates which variable or command is currently selected. Use the up/down arrow keys to move around the screen to access different fields. A selected parameter can be modified either by entering a number or by using the left/right arrow keys to increment the existing value to the next lower/higher value. The program always starts with the **Quick field calibration** command highlighted.

General Information — The first section of the main menu displays general information regarding sensor identification and history. This information includes the sensor serial number, date of manufacture, last calibration date, TEMA (time-extended measurement algorithm) on/off status, and the reading and %FS (percent of full scale) of the present analog output. Present date and time information is automatically generated by the computer.

Controller (Sensor) Settings — This section displays active controller settings for the sensor. Use this field to customize the sensor's operating parameters to match a particular application. Parameters that can be adjusted include relay alarm threshold limits, output type (volts or milliamps) and range, and proportional CO₂ output range.

RELAY — The sensor is equipped with a relay. The relay output switches ON (relay closes) at a preset CO₂ concentration threshold and OFF (relay opens) at an independently set lower level. These values can be changed by entering desired open/close values in the designated relay fields. In the example shown, the relay will close when the CO₂ level exceeds 1000 ppm, signaling a need for ventilation, and will reopen when levels drop below 900 ppm.

OUTPUT — When the analog output range field is highlighted, select either a voltage or current loop (milliamp) output by pressing the **u** key command to toggle between volt and milliamp units. Once the desired output type is

displayed, enter a value within the 0 to 10 V (4 to 20 mA) maximum range. To further maximize the output resolution of the sensor, enter a corresponding CO₂ output (measurement) range proportional to the selected analog output range.

Calibration — A periodic calibration check is necessary to maintain the desired accuracy of the sensor. This final section provides access to three calibration routines: Zero Point Calibration, Span Calibration, and Quick Field Calibration.

A full sensor calibration procedure consists of performing the Zero point and Span calibration steps, in that order. A faster and more convenient method is the Quick field calibration procedure, where each sensor is rapidly reset to a known CO₂ concentration.

NOTE: For applications requiring high accuracy, perform a full calibration, including Zero point calibration and Span calibration procedures.

During all calibration procedures, the UIP software provides on-line guidance and automatically makes all of the necessary sensor adjustments. Each full calibration (two step) procedure can be completed in less than 5 minutes; the Quick field calibration procedure can be completed in less than 3 minutes.

The "Concentration of present span calibration gas" field displays the concentration of gas last used to calibrate the instrument. Before beginning the span procedure, any new value should be entered here.

Connecting Calibration Components

1. Remove the sensor cover.
2. Cover the sensor body using the calibration adapter blanket (CAB) (Fig. 4, Item 1). Press firmly to ensure that the sample chamber is sealed. Use the metal clips (Fig. 4, Item 2) to secure the CAB snugly to the sample chamber body. Attach tubing (Fig.4, Item 3) to the regulator outlet (Fig. 4, Item 4) and connect to CAB. See Fig. 4.
3. Screw the regulator valve onto the correct gas bottle, according to the desired calibration procedure. See the following sections. A gentle hissing signals gas flow.
4. Refer to the following 3 sections for detailed calibration procedures.

QUICK FIELD CALIBRATION — Use the Quick Field Calibration procedure to adjust the reading to a known concentration of CO₂. To determine this value, either flow a known concentration of CO₂ gas through the sensor, or use a reliable and well-calibrated portable CO₂ level gauge to measure the level in the area where the sensor is located.

Proceed as follows:

1. Connect the computer to the sensor using the RS-232 communication cable and start the UIP.
2. Select the "Quick field calibration" option from the main menu and press **Enter**.
3. Using a reliable and well-calibrated portable CO₂ gauge as a reference, measure the ambient CO₂ level at the location of the sensor.
4. Read the corresponding CO₂ level that is displayed.
5. Enter the new value as displayed by the portable CO₂ gauge. See Fig. 5.
6. Exit program by pressing **Esc** and choose **Yes** to store new sensor parameters.

If using gas from the CO₂ gas bottle supplied with the calibration service kit, connect the calibration components and allow the gas to flow into the sample chamber. Allow the gas to flow for at least 3 minutes to ensure that the sensor is fully saturated. Enter the CO₂ concentration as displayed on the gas bottle (2000 ppm). Exit program by pressing **Esc** and choose **Yes** to store new sensor parameters.

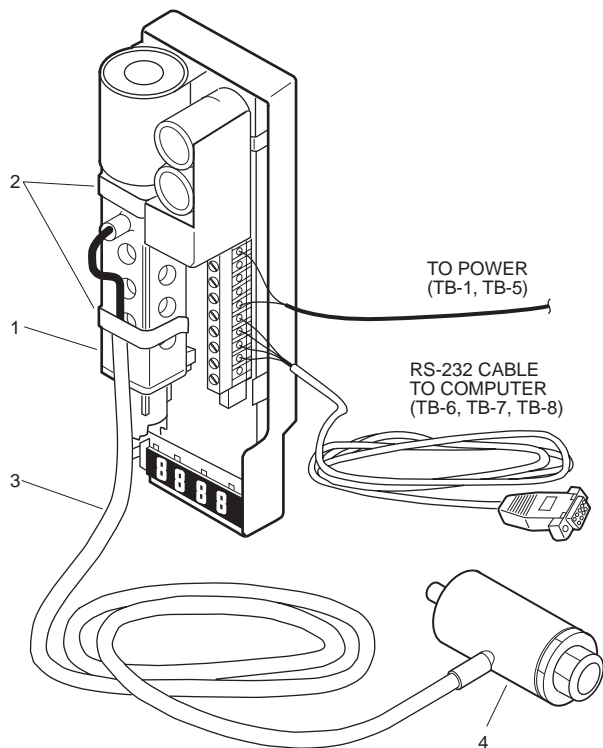


Fig. 4 — Connecting Calibration Components

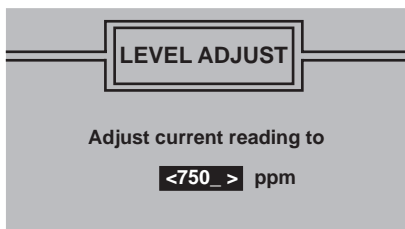


Fig. 5 — Entering Values for Quick Field Calibration

ZERO POINT CALIBRATION — During Zero point calibration, the UIP adjusts the zero point parameter so that the sensor's lamp power fits an internal calibration curve at the zero point value. Calibration can be performed during normal operation and should always be performed when the sensor is warmed up. Span calibration should always be performed after the Zero point calibration.

1. Connect the computer to the sensor using the RS-232 communication cable and start UIP program.
2. Select the **Zero point calibration** command from the main menu and press **Enter**.
3. Make all calibration component connections.
4. Connect the bottle of nitrogen gas to the regulator.
5. Turn on zero calibration (nitrogen) gas. A gentle hissing signals gas flow (0.5 liter/minute flow).

6. As the gas fills the sample chamber, the Zero mismatch field will begin to fluctuate.
7. When the Zero mismatch field has fully stabilized (minimum 3 minutes), press **Enter**.
8. In the final screen, the Zero mismatch should be centered as close to zero as possible. If the Zero mismatch differs from zero by ± 5 , then adjust the lamp power field by using the left/right arrow keys. Once the value is centered on zero (or as close to zero as possible) press **Enter** to accept new calibration settings.
9. To end the Zero point calibration session, press **Esc** and answer **Yes** to store the new calibration settings.
10. Proceed to the Span calibration section.

NOTE: To abort the Zero point calibration procedure and to return to previous calibration settings, press **Esc**.

Span Calibration — The span parameter is a software scaling factor affecting the slope of the sensor's internal calibration curve. For full calibration (two point), always perform the Zero calibration procedure first, and then proceed to Span calibration. The following Span calibration procedure assumes that all sensor/computer connections are still intact from the prior Zero point calibration procedure.

Proceed as follows:

1. With all other calibration component connections intact, remove the nitrogen gas bottle and replace it with the CO₂ gas bottle.
2. Enter the concentration of carbon dioxide to be used in the Calibration section of the main menu (2000 ppm).
3. Select the **Span calibration** option from the main menu and press **Enter**.
4. Open the gas bottle to start gas flow and wait at least 3 minutes to allow the CO₂ reading to stabilize.
5. Once the output reading is stable, press **Enter**.
6. To end the calibration session, press **Esc** and answer **Yes** to store the new calibration settings.
7. Disconnect RS-232 cable connections and remove the CAB slowly to avoid inducing static electricity and damaging the sensor.

NOTE: To abort the Span calibration procedure and return to previous calibration settings, press **Esc**.

In addition to saving new calibration settings to the sensor's EEPROM memory when exiting the program, it is possible to save the settings on a separate backup disk. To do so, select the **s** (save) command from the main menu. New sensor variables are not automatically saved to the sensor EEPROM unless **Yes** is selected at the end of the calibration procedure. If an error occurs before the new settings can be stored (for example, during a power failure), the most recently entered settings are automatically stored under the filename "LAST.SET." To load these settings onto the sensor, select the **I** (load) key command from the main menu.

Key Commands — Key commands are single-character commands which perform various functions in addition to the main menu options. Frequently used commands are displayed at the bottom of the main menu screen. A complete list of key commands can be viewed by pressing **h** (help). See Table 2 for a complete list of key commands.

Time-Extended Measurement Algorithm (TEMA)

Feature — The key command **u** toggles the TEMA feature On/Off. This feature is a self-calibration algorithm that minimizes long-term drift. If properly applied, the TEMA feature can reduce the sensor's annual drift to less than 30 ppm per year. When enabled, the TEMA feature records the lowest CO₂ concentration during each 24-hour period. This background CO₂ concentration is then compared with similar data taken over several days. If a significant change in the background CO₂ level is noted over a 24-hour period, a correction factor is automatically applied to compensate.

IMPORTANT: This feature should only be used when the sensor is installed in facilities that are unoccupied for at least 4 to 6 hours over each 24-hour period, thereby allowing CO₂ concentrations to drop to background levels.

Sensor Memory/Maintaining Backup Files —

All sensor settings including configuration, function, and calibration information are stored in the sensor's storage memory (EEPROM). During sensor power up, these values are loaded into the sensor's working memory.

In addition, the user interface program allows a computer file to be created after every setting or calibration adjustment to document any changes to the sensor. The user key commands **s** and **l** allow individual sensor settings to be stored and retrieved to sensor memory at any time. The user may also wish to use the **Print Screen** key command to create a hard copy of any adjustments or calibration changes done to the sensor. This command key is located on the keyboard, and can be pressed at any time when running the UIP.

To create a backup file for a sensor's individual settings, use the **s** (save) key command. By default, the sensor serial number becomes the filename. Press **Enter** to accept the default filename, or type in a new path and/or new filename. To view a list of existing files on the disk, press the space bar key. To view or change the path, press the **"** key. It is strongly recommended that a backup file be created for every new or recalibrated sensor in the event of a sensor memory problem.

To load a set of previously saved sensor variables from a disk to the working memory, select the **l** (load) key command. The load command affects only user-defined variable and settings. It does not affect the sensor serial number and production date.

IMPORTANT: If a file that originates from a different sensor is loaded, the unit requires recalibration.

When a working session is complete, always exit the program before disconnecting the RS-232 communication cable. When exiting the software, be sure to store all settings in the sensor EEPROM when prompted by the software. See Fig. 6. If this is not done, the sensor is restored to its settings at the time of login. As a safeguard, the UIP software keeps a copy of the last settings entered even if they are not saved by the user at the time of logout. The user can retrieve these unstored changes by selecting the file LAST.SET when executing the **l** (load) key command.

Default Settings — The default settings are sensor settings programmed at the factory prior to shipment. These settings are useful in the event of sensor memory error when valid start-up data is needed to activate communication between the sensor and UIP. To restore the default settings to the sensor, press the **d** (default settings) key command. When the default settings are restored, the UIP requests the sensor model type and asks if the calibration parameters should be reset. Answer **Yes** to fully recalibrate the sensor.



Fig. 6 — Storing Sensor Settings

Table 2 — Key Commands

PRESS KEY	COMMAND	ACTION
r	Restore settings	Restores sensor parameters to the values that existed when the program was started.
t	TEMA	Toggles the Time Extended Measurement Algorithm feature On/Off.
h	Help	Displays a complete list of key commands available in the UIP.
u	Unit type (output)	Toggles the output unit type between voltage and milliamp units.
v	Version	Displays the UIP version.
s	Save	Saves a backup file of sensor settings on disk.
l	Load	Loads a set of sensor variables from a previously saved disk file into the sensor working memory.
d	Default settings	Loads a set of sensor start-up variables assigned by the factory into the sensor working memory.
Esc	Escape (cancel)	Exit out of a subroutine, or when at the main menu, exit the UIP software.

TROUBLESHOOTING

Communication Error — The sensor should be powered on and warmed up before UIP communication can take place. If a communication error (Fig. 7) is generated at the UIP, confirm that the serial port number selected for the RS-232 connection at UIP start-up is the same as the port where the communications cable was installed. If the port number is correct, check the sensor power and communication cable connections.

Checksum Error — A checksum error message indicates a sensor memory failure. If this occurs, an error box with four options is displayed (in the preferred order). See Fig. 8. As a first option, **exit** the software, disconnect the RS-232 communications cable, and disconnect power from the sensor. A temporary memory error may be corrected when power is reconnected to the unit. If the error message is still present after restarting the sensor and UIP, restore data by loading a previously saved **backup** file. If a **backup** file of the sensor's settings does not exist, select the **Default** option in order to load the sensor microprocessor with valid start-up data. If all of the setting values and sensor readings are correct, the final **Continue** override option can be selected, but all set values and sensor readings should be carefully checked first for accuracy. If any of these values are incorrect, exit the software and reenter using the **Default** option.



Fig. 7 — Communication Error

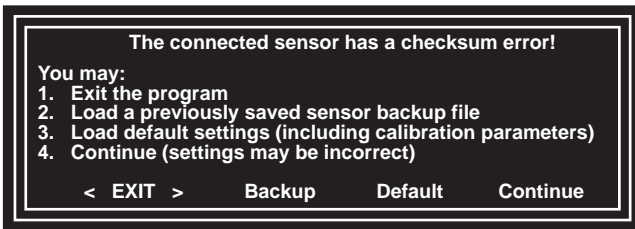


Fig. 8 — Checksum Error

REINSTALLING SENSOR COMPONENTS

Disconnect Calibration Kit and/or UIP Kit — Disconnect the kit components as follows:

1. Exit the UIP. If the program was run from the floppy disk, eject the disk for storage.
2. Disconnect DB-9 connector and communication cable from computer's serial port.

3. Disconnect wires from RS-232 terminals on sensor circuit board. See Fig. 4.
4. Turn off gas at regulator.
5. Remove clips holding the CAB in place.
6. Remove the CAB and tubing.
7. Disassemble tubing and regulator from gas bottle and store kit components.
8. See following sections for replacing sensor components.

Reinstall Circuit Board and Cover

1. Engage the left-hand side of the circuit board with the two tabs on the base (1 in Fig. 9) or aspiration box. Ensure that both of the tabs hook over the top of the circuit board. Press the right-hand side of the circuit board down until both spring clips (2 in Fig. 9) snap into place.
2. For the wall mounted base, engage the cover with the two tabs on the base (next to the display). See Fig. 9. Lower this part onto the base, being careful to line up the red/green LED (3) with the hole next to the display window until the spring tab (4) at the top of the unit snaps into place.
3. For the duct mounted application, close the aspiration box cover and screw tightly to prevent ambient air from entering the sensor chamber. The sensor cover is not needed to duct mounted applications, however, you may wish to keep it in the event that the sensor's sampling location is changed to a wall mounted application.

Handling the Circuit Board — The case offers the best protection against damage to the circuit board. Whenever possible, store the circuit board inside the case.

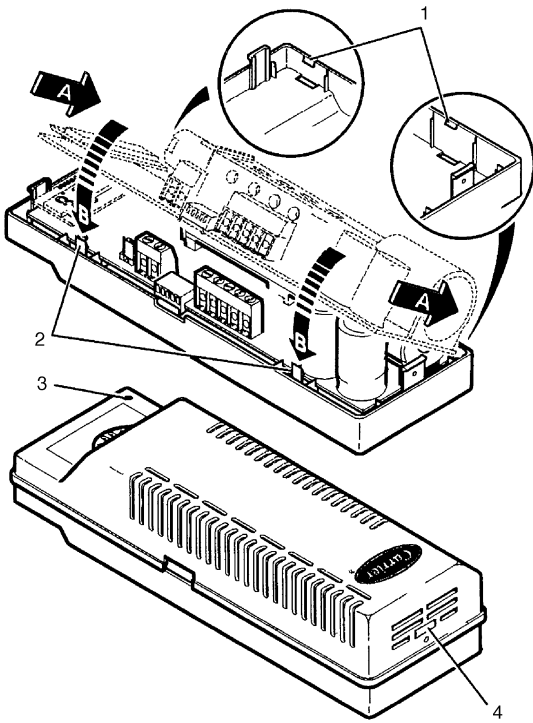
⚠ CAUTION

Static electricity can damage the circuit board. Be sure to use a properly grounded antistatic mat and/or grounded wristband while handling circuit board.

The user should be connected to electrostatic ground at all times when handling the circuit board. See Fig. 10. A wristband with ground strap (not included) is recommended, and can be purchased through an electronic parts supplier such as Radio Shack.

When handling the circuit board, hold it by the edges and avoid touching any electrical components. Use care when handling the circuit board. Do not splash liquids onto the board.

If the circuit board is left outside of the case for an extended period of time, precautions should be taken to protect it. Store the circuit board in an antistatic bag or box. Avoid exposure to direct sunlight or extreme heat or cold. The recommended storage temperature range is -40 to 158 F (-40 to 70 C).



**Fig. 9 — Reinstalling Circuit Board and Cover
(For Wall Mounting Applications)**

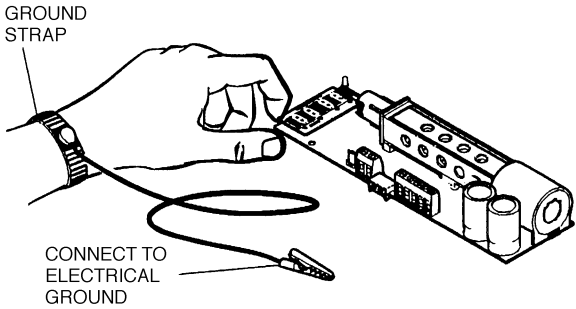


Fig. 10 — Electrostatic Ground Wristband

